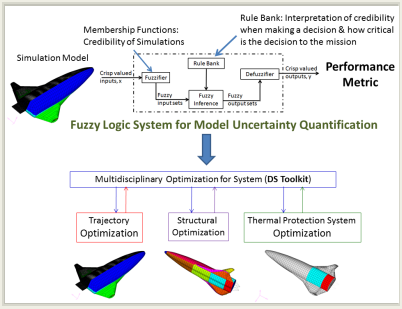
Small Business Innovation Research/Small Business Tech Transfer

Fusion of Modeling and Simulation Credibility in Multidisciplinary Design, Phase I

Completed Technology Project (2015 - 2016)

Project Introduction

Entry vehicle design and aircraft design are just two examples of systems that are of interest to NASA, requiring interactions and exchange of information among multiple performance disciplines. Since any computational optimization process relies on simulation models for identifying the impact of design changes in meeting performance expectations and improving metrics of goodness, it is essential that the uncertainty quantification of these models is captured by the optimization. Fuzzy Logic (FL) provides a systematic approach for introducing linguistic articulation of mental perception into a mathematical framework. In the proposed project the FL approach will be used for introducing in an automated multidisciplinary optimization process the human judgment and the expert opinion associated with the credibility of the modeling and simulations (as stated in the NASA-STD-7009) which are utilized for making decisions. The proposing firm has developed a Decision Support Toolkit (DS Toolkit) which can be used for multidisciplinary design and for balancing many multiple competing performance objectives. The multidisciplinary analysis is done automatically due to specialized algorithms and capabilities which are embedded in the DS Toolkit; both discrete and continuous design variables can be defined. The proposed research will develop the ability to consider the credibility of the models and of the simulations which are used for evaluating the performance requirements and the performance metrics during the analysis. A Fuzzy Logic System (FLS) capability will be developed for this purpose. The membership functions in the FLS will be reflecting the credibility scores assigned by subject matter experts to each one of the eight credibility factors of a simulation. The rule bank in the FLS will capture the expert opinion of the decision makers on how the credibility of the simulations will influences the decisions which are made by the optimization process.



Fusion of modeling and simulation credibility in multidisciplinary design, Phase I

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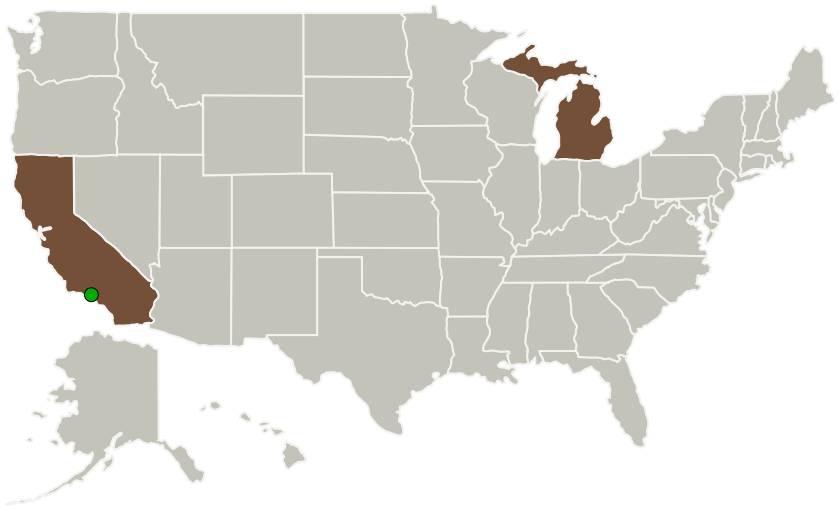
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Michigan Engineering Services, LLC	Lead Organization	Industry Women-Owned Small Business (WOSB)	Ann Arbor, Michigan
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
University of Michigan-Ann Arbor	Supporting Organization	Academia	Ann Arbor, Michigan

Primary U.S. Work Locations	
California	Michigan

Project Transitions

June 2015: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Michigan Engineering Services, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

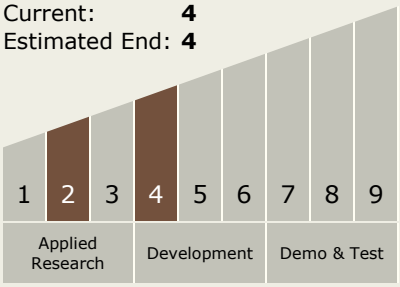
Carlos Torrez

Principal Investigator:

Geng Zhang

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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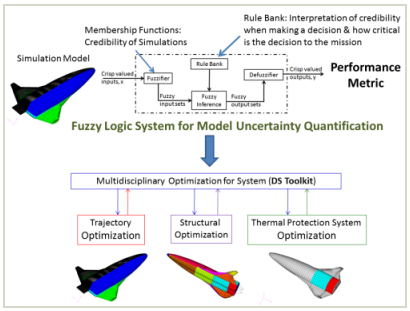
June 2016: Closed out

Closeout Summary: Fusion of modeling and simulation credibility in multidiscip linary design, Phase I Project Image

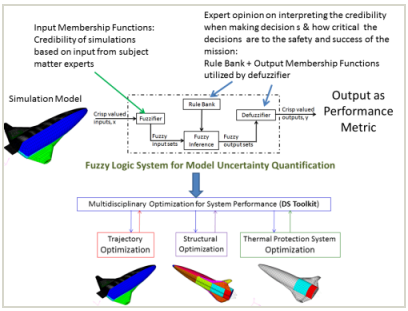
Closeout Documentation:

- Final Summary Chart Image*(https://techport.nasa.gov/file/139024)*

Images



Briefing Chart Image
Fusion of modeling and simulation credibility in multidisciplinary design, Phase I *(https://techport.nasa.gov/image/130306)*



Final Summary Chart Image
Fusion of modeling and simulation credibility in multidisciplinary design, Phase I Project Image *(https://techport.nasa.gov/image/136419)*

Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.2 Modeling
    - TX11.2.2 Integrated Hardware and Software Modeling

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System